

# PATENT SPECIFICATION

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## (54) WETSUITS AND DRYSUITS

(71) We, D.J. WETSUIT MANUFACTURING COMPANY LIMITED, of Leodis Works, Woodhouse Street, Leeds 6, West Yorkshire, a British company, do hereby declare this invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to wetsuits and drysuits.

Wetsuits and drysuits are used by both amateur and professional water sports participants and also by professional divers and other people engaged professionally in underwater or surface water work.

Wetsuits and drysuits as such are well known and normally are made out of an elastomeric material, e.g. a rubber such as neoprene, which is lined on one or both sides with a fabric such as a nylon fabric. Such material is waterproof and will be referred to hereafter as "wetsuit material". However wetsuits and drysuits also have seams in the arm and leg portions and also in the body portion of the suit. The seams have hitherto been made by stitching together abutting portions of wetsuit material and then stitching a thin strip of fabric to the wetsuit material on one side of the join. Seams have been formed in this way for many years. However the method of forming them is expensive in terms of labour costs and the maintenance costs of the sewing machines which are normally fairly complicated four needle sewing machines. Furthermore the resultant seams represent a weak point of the wetsuit or drysuit in that they are highly prone to leaking. Thus stretching of the material in the neighbourhood of the seams is liable to cause small openings to appear which will allow water to pass between the wetsuit material and the skin of the wearer. Although in a wetsuit there is intended to be a layer of water between the wetsuit material and the skin, this layer of water is supposed to remain stationary. If there is a flow of water

because of leakages at the seams then the wetsuit will not serve its purpose of providing heat insulation. The effect of leakages will be similar with the drysuit in which the stationary layer of water is replaced by an air layer.

According to the present invention there is provided a wetsuit or a drysuit having a seam in which adjacent portions of wetsuit or drysuit material are joined by a strip of material which is bonded to the wetsuit material by an adhesive provided from a bonding tape.

The strip of material may be any suitable tape and may for instance be nylon similar to that which lines the neoprene layer of the wetsuit material itself.

The bonding tape is preferably heat activated bonding tape such as the high strength bonding type sold under the trade mark SCOTCHWELD by 3M United Kingdom Limited. Preferred SCOTCHWELD bonding tapes are code numbers 582 and 584 in which the adhesive layer is provided with a liner which is removed so that the adhesive film may be applied. These tapes may be activated by heat and pressure and have been found to provide a high strength bond between the above-mentioned nylon strip and the nylon lining of the wetsuit material.

Before joining the portions of wetsuit material by the nylon strip and adhesive, the adjacent portions of wetsuit material may be butt-jointed by means of a suitable adhesive such as glue.

Nylon strips may be adhesively bonded to the wetsuit material either on one face of the join or on both faces.

The nylon strip may be bonded to the wetsuit material by means of the adhesive tape by a simple method involving the use of a heated iron or the like. Alternatively a machine having one or more heated rollers may be employed. Accordingly the present invention also provides a method for making a wetsuit or drysuit wherein adjacent portions of wetsuit or drysuit material are joined together by feeding said portions of material,

together with a nylon strip and an adhesive bonding tape, to a heated roller, the temperature, pressure and time conditions in the area of the join being sufficient to cause the adhesive to bond the nylon strip to the adjacent portions of wetsuit or drysuit material.

In one such method the nylon strip and bonding tape are fed separately to said heated roller.

In another such method the nylon strip and bonding tape are bonded together before being fed to said heated roller. In this case the nylon strip and bonding tape may be joined together by feeding them between two relatively movable plates, applying heat to at least one of said relatively movable plates and relatively moving said plates together to apply heat and pressure to said strip and tape to effect bonding therebetween. Preferably one of said plates is stationary and the other is movable both in a direction towards said stationary plate and also laterally with respect to said stationary plate to effect movement of the joined strip and tape away from said stationary plate and feed further unjoined strip and tape to said stationary plate.

The nylon strips may be obtained from much wider rolls of nylon by splitting the material to a suitable width, say, about one inch.

The present invention also provides apparatus for making a wetsuit or a drysuit including means for feeding abutting portions of wetsuit or drysuit material, together with a nylon strip and bonding tape, to a heated roller to effect the joining together of said portions by said strip and bonding tape.

An example of a seam in a wetsuit in accordance with the present invention and methods and apparatus for forming such a wetsuit, also in accordance with the present invention, will now be described with reference to the accompanying drawings, in which:—

FIGURE 1 is a cross-section through part of a wetsuit in accordance with the present invention;

FIGURE 2 is a schematic side view of apparatus for making a wetsuit in accordance with the present invention;

FIGURE 3 is an end view of the apparatus shown in FIGURE 2;

FIGURE 4 is a schematic side view of alternative apparatus which may be used for making a wetsuit in accordance with the present invention; and

FIGURE 5 is a schematic view of further equipment which may be used in conjunction with the apparatus of Figures 2, 3 or 4, for making a wetsuit or drysuit in accordance with the present invention.

Referring to FIGURE 1, a wetsuit is made from wetsuit material in which a layer of

neoprene 1 is sandwiched between sheets 3 and 5 of nylon fabric. Portions 7 and 9 of wetsuit material are butt-joined together at 11 by means of glue. On one side of the joined together portions of wetsuit material a strip of nylon fabric 13 is bonded to the wetsuit material so as to overlie the join 11 by means of a layer of adhesive 15. This adhesive layer 15 has been provided from a bonding tape such as the 3M SCOTCHWELD bonding tape number 582 or 584.

Referring to FIGURES 2 and 3 apparatus for making a wetsuit with a seam such as that shown in FIGURE 1 is essentially a free-standing machine comprising a support arm 17 which is positioned under a heated roller 19, the latter being mounted on a spindle 21 which is movable in a vertical direction but biased by compression springs 23 in a direction towards arm 17.

Means (not shown) are also provided for supporting a roll of nylon tape 25 and a roll of bonding tape 27 above roller 19.

Where a seam is to be formed in a leg or arm portion of a wetsuit a "tube" of wetsuit material is first of all formed by butt-joining portions of the material together using a suitable glue. This tube is then passed over the free end of arm 17 while the roller 19 is in a slightly raised position. The roller 19 is heated and the wetsuit material 29, nylon tape 31 and adhesive 33 from the bonding tape are fed by hand in the direction shown by the arrows in FIGURE 2 under roller 19 which is in its lowered position and pressing on the materials due to compression springs 23. The rate of feeding is controlled so that the contact time of the materials to be bonded together and the adhesive is appropriate for the temperature and pressure of the roller 19. Roller 19 may in fact be provided with an annular central recessed portion to accommodate the nylon tape and the surface of the roller on either side of the recessed portion may be roughened or otherwise machined to grip the wetsuit material as it is fed through.

In an alternative embodiment the arm 17 may be provided with an endless belt 101 which is arranged for movement about pulleys 103 and 105, the latter in turn being driven by a further belt arranged also around pulley 107. The upper run of belt 101 is arranged to contact the underside of the wetsuit material 29 (the belt may be provided with a serrated or notched surface to assist the gripping of the wetsuit material 29) so that material 29, bonding tape 33 and nylon strip 31 are trapped between belt 101 and heated roller 19 and moved in a direction shown by the arrow in Figure 2.

Referring to FIGURE 4 an alternative embodiment of a machine for forming a seam in a wetsuit such as that shown in FIGURE

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1 includes an arm 41 within which are mounted feed rollers 43 and 45 which are driven by a belt or other means (not shown). The machine is provided with two heated rollers 47 and 49 which are positioned between idler rollers 51 and 53. Rollers 47, 49, 51, 53 are mounted together for movement in a vertical direction but biased downwardly by means of compression springs 55 and 57. Another alternative embodiment of an apparatus for making a wetsuit having a seam such as that shown in FIGURE 1 may be similar to the machine of FIGURE 4 but the feed rollers 43 and 45 and associated driving means are omitted. Instead rollers 51 and 53 may be driven so as to feed the material past the heated rollers 47 and 49. However in this case the means for driving rollers 51 and 53 will have to be such as to allow for the raising and lowering of the roller assembly.

In a further alternative embodiment of apparatus in accordance with the present invention, the apparatus may be similar to that shown in Figures 2 and 3 except that the nylon strip and the bonding tape are joined together and are fed from a single roll. Referring to Figure 5 equipment for joining together the nylon strip and the bonding tape includes a roll 111 for feeding nylon strip 113 and a roll 115 for feeding bonding tape 117. Strip 113 and tape 117 are fed via guide rollers 119 and 121 between a pair of plates 123 and 125. Plate 123 is a fixed plate whereas plate 125 is mounted for movement in a direction towards and away from fixed plate 123. This movement is effected by means of a pair of pneumatic or hydraulic rams 127 and 129. Plate 125 is also mounted for movement laterally with respect to fixed plate 123, that is to say, in a direction shown by the double headed arrow 131. This movement is effected by a further pneumatic or hydraulic ram 133. The rams 127, 129 and 133 are all controlled automatically, by a central control arrangement 135 so that when a length of nylon strip 113 and bonding tape 117 is located between the plates 123 and 125, the fixed plate 123 being a heated plate, the rams 127 and 129 may be activated to cause the movable plate 125 to move towards heated plate 123 and apply pressure and heat to the strip and tape to cause them to be bonded together. For instance, the length of the plates may be about 8" and the working pressure about 100 psi.

After sufficient time for bonding, the movable plate 125 is moved away from fixed plate 123 and carries with it the bonding tape and nylon strip. Ram 133 is then activated to pull movable plate 125 in a direction towards it carrying with it the bonded nylon strip and bonding tape. The movable plate 125 is then returned to its original position

by ram 133 and the bonded together strip and tape 137 is pulled onto roller 139 so that when plate 125 has returned to its original position further unbonded strip 113 and tape 117 lie between the two plates and the sequence of operations can be repeated. Typically about 50 metres of strip and tape can be bonded together in about 8 minutes.

#### WHAT WE CLAIM IS:—

1. A wetsuit or drysuit having a seam in which adjacent portions of wetsuit or drysuit material are joined by a strip of material which is bonded to the wetsuit material by an adhesive provided from a bonding tape.

2. A wetsuit or drysuit according to claim 1 wherein the strip of material is made of nylon.

3. A wetsuit or drysuit according to claim 1 or claim 2 wherein the bonding tape is heat activated bonding tape.

4. A wetsuit or drysuit according to any of the preceding claims wherein adjacent portions of wetsuit or drysuit material are butt-jointed by a suitable adhesive in addition to being joined by said strip of material.

5. A method for making a wetsuit or drysuit wherein adjacent portions of wetsuit or drysuit material are joined together by feeding said portions of material, together with a nylon strip and an adhesive bonding tape, to a heated roller, the temperature, pressure and time conditions in the area of the join being sufficient to cause the adhesive to bond the nylon strip to the adjacent portions of wetsuit or drysuit material.

6. A method according to claim 5 wherein the nylon strip and bonding tape are fed separately to said heated roller.

7. A method according to claim 5 wherein the nylon strip and bonding tape are bonded together before being fed to said heated roller.

8. A method according to claim 7 wherein the nylon strip and bonding tape are joined together by feeding them between two relatively movable plates, applying heat to at least one of said relatively movable plates and relatively moving said plates together to apply heat and pressure to said strip and tape to effect bonding therebetween.

9. A method according to claim 8 wherein one of said plates is stationary and the other is movable both in a direction towards said stationary plate and also laterally with respect to said stationary plate to effect movement of the joined strip and tape away from said stationary plate and feed further unjoined strip and tape to said stationary plate.

10. Apparatus for making a wetsuit or drysuit including means for feeding abutting portions of wetsuit or drysuit material, together with a nylon strip and bonding tape, to a heated

roller to effect the joining together of said portions by said strip and bonding tape.

11. Apparatus according to claim 10 wherein said feed means include separate feed means for the nylon strip and the bonding tape.

12. Apparatus according to claim 10 and including means for bonding together said nylon strip and bonding tape before they are fed by single feed means to said heated roller.

13. Apparatus according to claim 12 wherein said bonding means include two relatively movable plates and means for heating at least one of said plates.

14. Apparatus according to claim 13 wherein one of said plates is a stationary plate and the other is movable both in a direction towards said stationary plate and also laterally with respect to said stationary plate so as to be able to effect movement of the joined strip and tape away from said stationary plate and to feed further unjoined strip and tape to said stationary plate.

15. A wetsuit or drysuit according to claim 1 and substantially as described herein.

16. A wetsuit or drysuit substantially as

described herein with reference to Figure 1 of the accompanying drawings.

17. A method according to claim 5 and substantially as described herein.

18. A method for making a wetsuit or drysuit substantially as described herein with reference to Figures 2 and 3, or Figure 4 of the accompanying drawings.

19. Apparatus according to claim 10 and substantially as herein described.

20. Apparatus for making a wetsuit or drysuit substantially as described with reference to Figures 2 and 3, or Figure 4 of the accompanying drawings.

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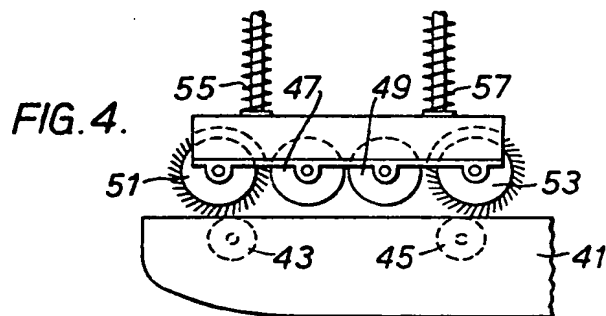
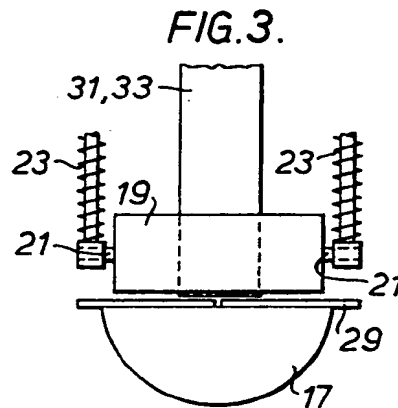
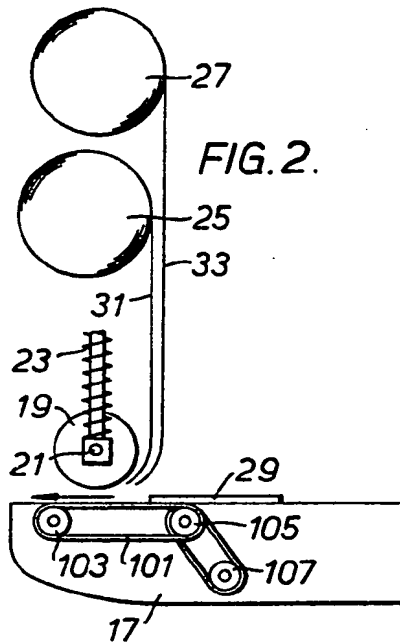
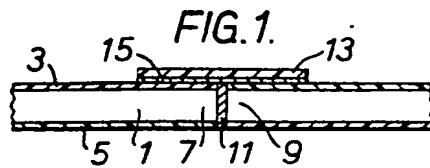
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